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भारतीय मानक

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भाग 1 सामान्य अपेक्षाएँ तथा मापन पद्धतियां
अनुभाग 1 सामान्य

(दूसरा पुनरीक्षण)

Indian Standard

RADIO FREQUENCY CONNECTORS

PART 1 GENERAL REQUIREMENTS AND MEASURING METHODS

Section 1 General

(Second Revision)

UDC 621.315.683.029.5 : 621.38/39.038

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BUREAU OF INDIAN STANDARDS
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NEW DELHI 110002

June 1995 Price Group 11

Connectors for Electronic Equipment Sectional Committee, LTD 16

NATIONAL FOREWORD

This Indian Standard (Part 1/Sec 1) which is identical with IEC Pub 169-1 : 1987 'Radio frequency connectors: Part 1 General requirements and measuring methods', issued by the International Electrotechnical Commission was adopted by the Bureau of Indian Standards on the recommendation of the Connectors for Electronic Equipment Sectional Committee (LTD 16) and approval of the Electronics and Telecommunication Division Council.

This Indian Standard was originally published in 1969. It was subsequently revised in 1980. The present revision has been taken up to adopt the present international practice in this field. Hence the latest IEC Pub 169-1 : 1987, has been adopted as Indian Standard under dual number procedure.

The series of standards on Radio frequency connectors : Part 1 General requirements and measuring methods comprise of following sections:

Section 1	General
Section 2	Electrical tests and measuring procedures — reflection factor
Section 3	Electrical tests and measuring procedures — screening effectiveness

CROSS REFERENCES

In this Indian Standard (Part 1/Sec 1), the following International Standards are referred to. Read in their respective place the following:

International Standard	*Corresponding Indian Standard*	*Degree of Correspondence*
IEC 50 International electrotechnical vocabulary	IS 1885 Electrotechnical vocabulary	Technically equivalent
IEC 50-151 : 1978 Electrical and magnetic devices	IS 1885 (Part 74) : 1993 Electrotechnical vocabulary : Part 74 Electrical and magnetic devices	Identical
IEC 68 Basic environmental testing procedures	IS 9000 Basic environmental testing procedure for electronic and electrical items	Technically equivalent
IEC 68-1 : 1982 : Part 1 General and guidance	IS 9000 (Part 1) : 1988 Basic environmental testing procedures for electronic and electrical items: Part 1 General *(first revision)*	Technically equivalent
IEC 68-2-1 : 1974, Part 2 Tests — Test A : Cold	IS 9000 (Part 2/Sec 1) : 1977 Basic environmental testing procedures for electronic and electrical items: Part 2 Cold test, Section 1 General	do
IEC 68-2-2 : 1974 : Test B : Dry heat	IS 9000 (Part 3/Sec 5) : 1977 Basic environmental testing procedures for electronic and electrical items: Part 3 Dry heat, Section 5 Dry heat test for non-heat dissipating items with gradual change of temperature	do
IEC 68-2-3 : 1969 : Test Ca : Damp heat, steady state	IS 9000 (Part 4) : 1979 Basic environmental testing procedures for electronic and electrical items: Part 4 Damp heat (steady state)	do

(Continued on third cover)

Indian Standard
RADIOFREQUENCYCONNECTORS
PART 1 GENERAL REQUIREMENTS AND MEASURING METHODS
Section 1 General
(Second Revision)

1. **Scope**

This standard relates to connectors for r.f. transmission lines for use in telecommunications, electronic and similar equipment.

2. **Object**

This standard shall serve as a generic specification providing the basis for the sectional standards which apply to individual connector types. It is intended to establish uniform concepts and procedures concerning:

- terminology:
- standard ratings and characteristics;
- testing and measuring procedures concerning electrical and mechanical properties;
- classification of connectors with regard to environmental testing procedures involving temperature, humidity and vibration.

The test methods and procedures of the standard are intended primarily for type approval testing. They may also be adopted, by agreement between manufacturer and customer, to serve as a basis for acceptance tests.

3. **Terminology**

For the purpose of this standard, the following definitions apply:

3.1 *General, parts of connectors*

3.1.1 *(Electrical) Contact*

The state in which individual electrically conductive parts are in such close mechanical touch as to provide a low resistance path to electrical current in either direction.

3.1.2 *Contact*

The conductive element in a component which mates with a corresponding element to provide an electrical path (to provide electrical contact).

3.1.3 *Male contact*
Pin contact

A contact intended to make electrical engagement on its outer surface and which will enter a female (socket) contact.

3.1.4 *Female contact*
Socket contact

A contact intended to make electrical engagement on its inner surface and which will accept entry of a male (pin) contact.

3.1.5 *Hermaphroditic contact*

A contact which is intended to mate with an identical contact.

3.1.6 *Resilient contact*

A contact having elastic properties to provide a force to its mating part.

3.2 *Basic connector terms*

3.2.1 *Connector*

A component normally attached to a cable or mounted on a piece of apparatus (excluding an adaptor) for electrically joining separable parts of a transmission line system.

3.2.2 *Connectorpair*

Two connectors having complementary mating faces and locking means, so as to be mateable and interlockable.

3.2.3 *Type*
Series

Terms characterizing the particular mating faces and locking means of a connector pair with regard to construction and dimensions.

Note. — The term "series" is sometimes used as an approximate synonym of *type" for designating the entirety of connector styles with identical mating face and locking means.

3.2.4 *Style*

A particular form or shape of connector, as well as a combination of connectors of the same type. Examples are: free and fixed connectors, both straight and right angle, within-type adaptors straight and right angle.

Note. — For 'adaptor", see Sub-clauses 3.5.1 to 3.5.6; a 'within-type adaptor" may also be considered as a particular style of a given type.

3.2.5 *Variant*

A variation of a style in particular details, such as cable-entry dimensions.

3.2.6 *Grade*

A qualification of a connector with regard to mechanical and electrical precision in particular with respect to a defined reflection factor.

3.2.7 *Generalpurpose connector: Grade 2*

A connector making use of the widest permitted dimensional deviations (tolerances) so as still to guarantee minimum stated performance and intermateability.

Note. — A requirement for the reflection factor may or may not be specified.

3.2.8 *High performance connector: Grade 1*

A connector for which limits of reflection factor are specified as a function of frequency. No tighter dimensional tolerances than those applicable to Grade 2 are normally specified. The manufacturer is responsible, however, for choosing tighter tolerances where necessary to ensure that the reflection factor requirements are met.

3.2.9 *Standard test connector: Grade 0*

A precisely made connector of a particular type used to carry out reflection factor measurements on Grade 1 and Grade 2 connectors, contributing only negligible errors to the measuring result.

Nore. — The standard test connector is often part of an inter-type adaptor which allows connection with a precision connector forming part of the measuring equipment.

3.2.10 *Precision connector*

A connector that has coincident mechanical and electrical reference planes, air dielectric, and has the property of making connections with a high degree of repeatability without introducing significant reflections, loss or leakage. It is intended for mounting on air-lines and instruments. Precision connectors can be of the hermaphroditic type, flange type or of the pin and socket type as stated in IEC Publication 457-l: Rigid Precision Coaxial Lines and their Associated Precision Connectors, Part 1: General Requirements and Measuring Methods.

3.2.11 *Laboratory precision connector (LPC)*

A precision connector-without dielectric support for the centre conductor.

3.2.12 *General precision connector (GPC)*

A precision connector with self-contained dielectric support capable of supporting the unsupported centre conductor of an LPC and standard air-line with which it is mated.

3.3 *Constructional terms*

3.3.1 *Male connector*
Pin connector

A connector containing a male centre contact.

3.3.2 *Female connector*
Socket connector

A connector containing a female centre contact.

3.3.3 Plug connector

A connector featuring the active part of the coupling mechanism, i.e. the nut or bayonet ring, and which normally is a free connector.

Note. — Depending on the particular type, a plug may be a male or a female connector.

3.3.4 Socket

A connector complementary to the plug.

3.3.5 *Hermaphroditic connector*

A connector which mates with an identical connector.

Note. — The coupling (locking) means need not be hermaphroditic.

3.3.6 *Free connector*

A connector for attachment to a free end of a cable. It is normally a plug.

Note. — If not specified as fixed, a connector is assumed to be free.

3.3.7 *Fixed connector*

A connector with provision for attachment to a mounting surface. It is normally a socket.

3.4 *Sealing*

3.4.1 Sealed connector

A connector employing a seal capable of fulfilling specified gas-, moisture- or liquid-tightness requirements.

3.4.2 *Barrier seal*

A seal preventing the passage of gases, moisture or liquids in an axial direction within the body shell of a connector.

3.4.3 ***Panel seal***

A seal preventing the passage of gases, moisture or liquids between the fixed connector or adaptor body shell and the panel via the mounting hole(s).

Note. — The sealing member is often provided as a discrete item.

3.4.4 ***Mating face seal***

A seal preventing the passage of gases, moisture or liquids into the interface space of a pair of mated connectors.

3.4.5 ***Hermetic seal***

A seal meeting the requirements specified on application of Test Qk of IEC Publication 68-2-17: Basic Environmental Testing Procedures, Part 2: Tests, Test Q: Sealing.

3.5 *Miscellaneous terms and terms concerning measuring equipment*

3.5.1 ***Adaptor***

A two-port device for joining two transmission lines having non-mating connectors.

3.5.2 ***Fixed adaptor***

An adaptor with provision for attachment to a mounting surface.

Note. — If not specified as fixed, an adaptor is assumed to be free.

3.5.3 ***Within-type adaptor***

An adaptor for use between two or more connectors all of the same type.

3.5.4 ***Inter-type adaptor***

An adaptor for use between two or more connectors of different type.

3.5.5 Standard test ***adaptor***

An inter-type adaptor for test purposes, having a standard test connector at one end and a precision connector at the other end.

3.5.6 ***Standard air line***

A homogenous air dielectric transmission line having the smallest possible irregularities in diameter and straightness of conductors, no self-contained supports for the inner conductor and using non-magnetic material with good conductivity.

3.5.7 ***Referenceline***

An air line similar to the standard air line but with dielectric support of the inner conductor, and with a design such that the internal reflection factor is kept at a minimum within the frequency range made use of for measurements.

3.5.8 ***Cable simulator***

A section of precise transmission line with accurate characteristic impedance, in general a precision cable, to which the connector under test is attached in such a way that the transition from line to connector simulates as precisely as possible the normal state of the connector attached to an appropriate cable (in particular with regard to reflection factor and reactive disturbances).

3.6 *General electrotechnical terms*

Note. — The following terms and definitions are taken from IEC Publication 50(151): International Electrotechnical Vocabulary (IEV), Chapter 151: Electrical and Magnetic Devices, where they are numbered 15 l-04-01, 15 l-04-02 and 15 l-04-03, respectively. The note added to Sub-clause 3.6.1, nominal value, is for the purpose of this standard.

3.6.1 Nominal value

A suitable approximate quantity value used to designate or identify a component, device or -equipment.

Note. — It follows from the definition that a nominal value is not subject to tolerances.

3.6.2 Limiting value

In a specification, the greatest or smallest admissible value of-one of the quantities.

3.6.3 Rated value

A quantity value assigned, generally by a manufacturer, for a specified operating condition of a component, device or equipment.

4. **Units, synibols and dimensions**

4.1 *Units and symbols*

Units, graphical symbols, letter symbols and terminology shall whenever possible, be taken from the following publications:

ZE C publications:

27: Letter Symbols to be Used in Electrical Technology.

50: International Electrotechnical Vocabulary (IEV).

6 17: Graphical Symbols for Diagrams.

Other-publication:

IS0 Standard 1000 (1981): SI Units and Recommendations for the Use of their Multiples and of Certain Other Units.

4.2 *Dimensions*

4.2.1 Details to *beprovided in relevant specifications*

Each relevant specification shall provide:

i) sufficient dimensional information on the mating faces of general purpose and standard test connectors as to ensure intermateability and compliance with performance requirements;

ii) information on the connector envelope maximum dimensions to enable the user to accommodate the connectors in his equipment.

The essential purpose of the drawings is to ensure mechanical interchangeability and adequate electrical performance; they are not, however, intended to restrict details of construction which do not effect interchangeability or performance, nor are they to be used as manufacturing drawings.

Note. — Equipment designers should work to the limits stated in the outline drawings and not to the dimensions of individual specimens.

4.2.2 *Dimensional units to be used in specifications*

The dimensions and tolerances shall be given in both millimetres and inches. The original system of units shall be stated.

Independent of the system of units, the highest accuracy required by the dimensions shall be such that the values, the first digit of which is 1 or 2, shall not comprise more than five digits, those with the first digit being 3 to 9 shall not have more than four significant digits. In any case, the precision shall be limited to 1 µm or 0.00005 in.

4.2.3 *Conversion of dimensionsgiven in inches into millimetres and vice versa*

During the conversion of the dimensions, in principle they shall be rounded to the nearest 0.001 mm or 0.00005 in. Where, however, mechanical and electrical considerations permit, the rounding shall usually be to the nearest 0.01 mm or 0.0005 in. This also holds for the conversion between the systems of units after having made the exact calculation according to IS0 Standard 370: Toleranced Dimensions, Conversion from Inches to Millimetres and Vice Versa.

A note shall be added to each specification reading:

> "The values for the dimensions in.. .*... derived from those in.. .*... are not necessarily exact according to IS0 Standard 370: Toleranced dimensions - Conversion from inches into millimetres and vice versa. They are, however, to be considered as acceptable rounded values with regard to accuracy.
>
> **Note.** — For more details see Publication 169-1, Sub-clause 4.2."

5. Standard ratings and characteristics

The ratings and characteristics applicable to each connector type and style shall be stated in the relevant specification. They should normally cover:

- a short description of the connector construction stating in particular the inner diameter of the outer conductor and, if applicable, the cable types preferably to be used with the connector;
- the reflection factor as a function of frequency for the different grades (if applicable) together with the conditions for which it is valid;
- the working voltage at different altitudes (pressures);
- the climatic categories;
- any other rating or characteristic applicable.

6. Classification into climatic categories

The classification of connectors with regard to climatic conditions is based on I EC Publication 68-l: Part 1: General and Guidance, and indicated by a series of three sets of digits separated by oblique strokes corresponding respectively to tests at low temperature (minus sign not shown), high temperature and the number of days of exposure to damp heat, steady state.

The climatic severities to be prescribed by the relevant specification shall preferably, but not necessarily, be selected from the following preferred values:

Low temperature (°C)	High temperature (°C)	Duration of damp heat, steady state (days)
-40	+ 85	4
-55	+125	21
	+155	56

---

* Millimetres or inches to be entered as applicable.

The following two groups are recommended as preferred climatic categories for r.f. connectors:

40/085/21
55/155/21

7. Quality assessment

This standard serves also as Generic Specification for the I EC Quality Assessment system (IECQ). The necessary additional specifications for this purpose will form IEC Publication 169-l-4: Section Four — Quality Assessment (in preparation).

8. Marking

8.1 *Marking of the component*

Each component shall be legibly and durably marked, where space permits and in the following order of precedence, with:

a) identity code of manufacturer;

b) manufacturer's connector identification code or I EC connector designation.

If the nominal impedance of a connector is to be indicated by colour coding, the following convention shall be used:

50 Ω: no additional colouring   75 Ω: yellow or black band

8.2 *Marking and contents ofpackage*

The package shall be marked with the information prescribed in Sub-clause 8.1 and, in addition, the following information shall be given:

a) nominal characteristic impedance;

b) manufacturing date code;

c) any additional marking required by the relevant specification.

When required by the relevant specification, the package shall also include instructions for assembling the connector(s) and instructions for the use of any special tools or materials, as necessary.

9. IE C type designation

The purpose of the IEC type designation is to identify a particular connector within the scope of IEC r.f. connector standardization. It is not intended to include information in excess of this. In practice it is usually necessary to identify a manufacturer's product because, although complying with the IEC standard, there may be features not covered by the standard.

Connectors complying with the relevant specification shall be designated by the following indications and in the order given:

a) the number of the specification;

b) the letters "IEC";

c) additional identification as indicated in the relevant specification.

Note. — When an I-EC type designation is used, either for the marking of the product or in a description of the product, it is the responsibility of the manufacturer to ensure that the item meets the requirements of the relevant specification. The I EC as a body cannot accept responsibility in this matter.

CHARTER II: TEST AND MEASURING METHODS

10. **General**

This chapter comprises the description of electrical and mechanical measuring methods, environmental conditionings and testing procedures to be used in particular for type testing, but which are also applicable to other testing purposes. In general no requirements are directly specified. However, where appropriate, one or more preferred severities are given.

The relevant specification shall prescribe those tests, measuring methods and procedures, taken from the library of tests as contained in this chapter, needed for a specific product, together with the appropriate severities and requirements.

For technical reasons some of the tests have to be carried out in a definite sequence on the same specimens. Separate specimens may be required for different sequences. Since, further, for some tests the specimens undergo a treatment which excludes them from being sold, it is an economic measure to form appropriate test groups.

A schedule of test groups taking into account the above is shown in Appendix A. This schedule is expected to be applicable, in principle, to all types of connectors, deleting those tests or sequences not required for a particular type or style.

According to the schedule, all specimens of a test sample should be submitted to the first group of tests. The sample is then split up into the required number of equal sub-samples of not less than four pairs of connectors, unless otherwise specified.

11. **Standard conditions for testing**

Unless otherwise specified, the following conditions shall apply:

- tests shall be carried out under Standard Atmospheric Conditions for Testing as specified in I EC Publication 68- 1;
- before measurements are made, the connectors shall be preconditioned under standard atmospheric conditions for testing for a time sufficient to allow the entire connector to reach thermal stability;
- recovery conditions for the interval after ‘a conditioning and the next measurement or test shall be in accordance with I EC Publication 68- 1.

The test schedule is shown in Appendix A and details of conditionings in Clause 16.

The test shall be carried out with connectors as received from the supplier. In no case shall the contact parts be cleaned or otherwise prepared prior to tests, unless explicitly stated in the specification.

If it is required that a cable shall be attached to a connector, this shall be done in accordance with the connector manufacturer’s instructions (normally supplied with the connectors).

When mounting is required in a test, the connector shall be securely mounted on a rigid plate of suitable material, using a clamp for free connectors or the normal fixing for fixed connectors. The dimensions of the mounting plate shall be such that the contour of the specimen is exceeded.

12. Visual inspection

Visual inspection shall include a check on:

a) The marking:
it shall be correct in accordance with Sub-clause 8.1 and be legible after any of the specified tests.

b) The manufacture:
it shall have been carried out in a careful and workmanlike manner.

c) Deterioration after electrical, mechanical and climatic tests:
unless otherwise specified, there shall be no visible deterioration likely to affect the performance.

d) The marking on the package:
it shall be in accordance with Sub-clause 8.2.

13. Dimensions

The dimensions shall be checked and shall comply with those specified by the relevant specification.

Any suitable method may be used, except that gauges shall be used where specified by the relevant specification.

14. Electrical tests and measuring procedures

14.1 *Reflection factor*

See IEC Publication 169-1-1: Section One — Electrical Tests and Measuring Procedures: Reflection Factor.

14.1.6 *Information to be given in the relevant specification*

a) limits for the reflection factor as a function of frequency appropriate to the grade;

b) measuring accuracy;

c) details of the standard test connector;

d) necessary characteristics of the appropriate cable;

e) any deviation from the standard test method.

14.2 *Power rating*

See IEC Publication 169-1-2: Section Two — Electrical Tests and Measuring Procedures: Power Rating (in preparation).

14.3 *Contact resistance and outer conductor continuity*

14.3.1 *General measuring requirements and procedure*

Measurements will in general be carried out with alternating current (a.c.). In case of dispute, however, the measurement with direct current shall govern. The frequency for a.c. measurements shall be 1 kHz ± 200 Hz.

The contact resistance shall normally be calculated from the potential difference measured between the points intended for the connection of the cables and the current. The contact shall be made before the current is switched on. Where connection points for measuring the potential difference sufficiently near to the contact are not accessible, corrections shall be made for the length of wire or cable in series with the contact.

In order to prevent the breakdown of possible insulating layers on the contacts, the electromotive force (e.m.f.) of the measuring circuit shall not exceed 20 mV (peak value for a.c.).

In order to prevent undue heating of the contacts, the current shall not exceed 1 A or the value specified by the relevant specification.

The measuring set-up shall be such as to ensure that the result is within ± 10% of the resistance to be measured, unless another accuracy is given in the relevant specification.

In general the resistances of the centre contact R_c and the outer contact R_o of a pair of connectors shall be measured separately. The relevant specification shall state explicitly if the total resistance R_{tot} of the two contacts in series is to be determined by a direct measurement.

14.3.2 *Procedure*

The relevant value of the contact resistance is the mean value calculated from live consecutive measuring cycles. No individual value shall exceed twice the mean value.

One measuring cycle consists of:

when measuring with a.c.:

a) making the contact (engaging the connectors);

b) connection of voltage source;

c) measurement;

d) disconnection of voltage source;

e) breaking the contact (disengaging the connectors).

when measuring with d.c.:

a) making the contact (engaging the connectors);

b) connection of voltage source in one polarity;

c) measurement;

d) connection of voltage source in opposite polarity;

e) measurement;

f) disconnection of voltage source;

g) breaking the contact (disengaging the connectors).

14.3.3 *Requirements*

The value of the contact resistance shall not exceed the value specified by the relevant specification.

14.3.4 *Information to be given in the relevant specification*

a) Upper limit of resistance for centre contact and outer contact, if applicable also of total resistance;

b) any deviation from standard procedure.

14.4 *Centre and outer conductor contact continuity under severe mechanical conditioning*

14.4.1 *Testing procedure*

The continuity of the centre and the outer contacts of a mated pair of connectors shall be tested during the vibration (see Sub-clause **15.2.2**), the bump (Sub-clause 15.7) and the shock test (Sub-clause **15.8**), as required by the relevant specification.

The test equipment, for instance an oscilloscope or an electronic apparatus with adequate display or permitting the counting of interruptions, shall have a resolution of better than 1 µs.

A current of at least 100 mA shall be flowing through each set of contacts. Contacts may be connected in series. Other values may be specified for the current in the relevant specification.

14.42 *Requirements*

There shall be no intermittences under the conditions specified by the relevant specification.

14.4.3 *Information to be given in the relevant specification*

See Sub-clauses 15.2.2, 15.7 and 15.8.

14.5 *Insulation resistance*

14.5.1 Procedure

The insulation resistance shall be measured between the contacts with a d.c. voltage of 500 ± 50V or with the rated voltage of the connector whichever is less.

The insulation resistance shall be measured after an electrification time of 1 min ± 5 s.

Note. — When appropriate, the reading may be taken after a shorter period.

14.5.2 *Requirements*

The value of the insulation resistance shall be not less than the value specified by the relevant specification.

14.5.3 *Information to be given in the relevant specification*

a) value of the test voltage if other than 500V;

b) minimum value of insulation resistance;

c) any deviation from the standard test procedure.

14.6 *Voltage proof*

14.6.1 *Procedure and requirements*

Connectors shall withstand without breakdown or flashover the voltage specified by the relevant specification.

An appropriate cable shall be attached to the connectors and the connectors shall be tested both mated and unmated.

An a.c. voltage at a frequency between 40 Hz and 60 Hz shall be applied for 1 min between the conductors of the cable.

The relation between the rated voltage U and the test voltage E (r.m.s. values) is given by:

$E = 3\,U$ for connectors having a rated voltage up to and including 1 kV and

$E = 1.5\,U$, with a minimum of 3 kV, for connectorshaving a rated voltage exceeding 1 kV.

14.6.2 *Information to be given in the relevant specification*

a) value of the test voltage;

b) any deviation from the standard test procedure.

14.7 *Water immersion test*

14.7.1 *Procedure and* requirements

Suitably mated connectors fitted with mating face seals and attached to appropriate cables shall be submerged in tap water at 70 ± 2 °C to a depth of 30 cm.

After 1 h the water shall be allowed to cool to room temperature and shall be held at this temperature for 1 h. The water shall then be cooled to 10 ± 2°C in approximately 1 h and then kept at this temperature for 1 h.

The water shall then be allowed to warm up to room temperature. The connectors shall remain under water until 24 h have elapsed from the time of starting the test. Whilst still submerged, the following test and measurement shall be carried out as required by the relevant specification:

a) Voltage proof

An a.c. voltage as specified in the relevant specification shall be applied at a frequency between 40 Hz and 60 Hz between the inner contact and the body of the connector for a period of 1 min. There shall be no breakdown or flashover.

b) Insulation resistance

The insulation resistance shall be measured in accordance with Sub-clause 14.5.

14.7.2 *Information to be given in the relevant specification*

a) value of the test voltage;

b) any deviation from the standard test procedure.

14.8 *Screening effectiveness*

See IEC Publication 169-l-3: Section Three — Electrical Test and Measuring Procedures: Screening Effectiveness (in preparation).

14.9 *Capacitance*

This test has been omitted from this second edition.

14.10 *R.F. shunt resistance*

This test has been omitted from this second edition.

14.11 *Discharge test (corona test)*

14.11.1 *Procedure and requirements*

For this test, an appropriate cable shall be attached to the connector and the test voltage shall be applied between the conductors of the cable. No grease or similar compounds shall be used in or on the test sample.

The application of a high voltage to the test samples immediately before the discharge test, may affect the measured results; a rest interval is therefore recommended, after previous voltage application, before carrying out the discharge test,

Care shall be taken to avoid spurious effects caused by corona at the cable ends.

The connectors shall be tested only in the mated condition.

The voltage to be applied shall have a frequency between 40 kHz and 60 kHz. The total duration of the application of the voltage shall not exceed 5 min.

The circuit for this test shall be as shown in Figure 1, page 33, or a circuit giving the same results.

To allow the measurement of the discharges, the components of the test circuit shall be corona free to the extent that discharges of 5 pC or more occurring in the test specimen are not obscured. The parts submerged in oil shall be purged of air.

The voltage shall be slowly increased until the detector, operated at a sensitivity of 5 pC, indicates a sustained corona discharge. Then the voltage shall immediately be decreased until corona is at the 5 pC level, the corresponding voltage being the corona level of-the connector under test.

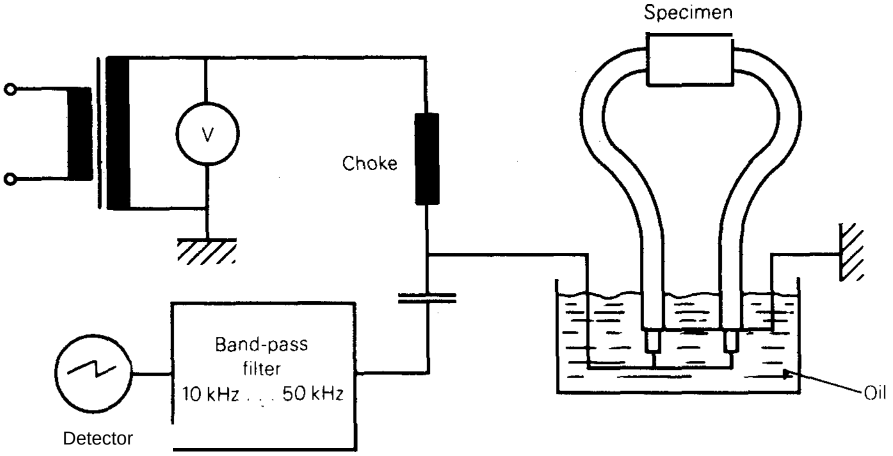

FIG. 1. — Measuring circuit for the discharge test.

14.1 1.2 *Information to be given* in *the relevant specification*

a) minimum value of the extinction voltage;

b) any deviation from the standard test procedure.

15. Mechanical tests and measuring procedures

15.1 *General*

Measurements to be made at any stage of these tests shall be indicated in the relevant specification.

15.2 *Soldering, vibration, gauge retention force, effectiveness of contact captivation*

Note. — These tests formed a "standard testing sequence" in the first edition but are now to be considered as individual tests. The test called "static load" has been deleted.

15.2.1 Soldering

Terminations to which soldered connections have to be made shall be tested to ensure that the surfaces wet easily and that damage does not occur by assembly soldering processes. Tests shall be carried out in accordance with Test Ta of I EC Publication 68-2-20: Test T: Soldering, and when required the relevant specification shall identify the termination(s) and provide the information as indicated for Test Ta. Test Tb may be applied if specified in the relevant specification.

15.2.2 *Vibration*

15.2.2.1 Procedure

The test shall be carried out on mated sets of connectors in accordance with Test Fc of I EC Publication 68-2-6: Test Fc and Guidance: Vibration (Sinusoidal).

The vibration severity to be prescribed by the relevant specification shall, preferably, be selected from amongst the following preferred values:

Swept frequency ranges:	10 Hz to 150 Hz 10 Hz to 500 Hz 10 Hz to 5 000 Hz.
Vibration amplitude:	0.75 mm constant displacement amplitude up to the cross-over frequency (57.5 Hz), 98 m/s^2 constant acceleration amplitude above.
Approximative endurance duration:	30 min, 90 min. The duration shall be equally divided among the directions specified.

The connectors shall be attached to a suitable length of appropriate cable and the mated pair of connectors mounted in one of the following ways, as prescribed by the relevant specification:

a) clamping both the connectors and the cable;

b) clamping the cables only and thus leaving the connectors freely suspended;

c) if one of the connectors is a fixed style, this connector shall-be mounted in accordance with Clause 11.

The connectors shall be vibrated in each of three perpendicular directions, one of which shall be parallel to the common axis of the connectors.

The centre and the outer contact continuity shall be monitored as specified in Sub-clause 14.4.

15.2.2.2 *Information to be given in the relevant specification*

a) appropriate cable to be used, the details of cable support and anchorage:

b) severities;

c) performance requirements;

d) any deviation from the standard test procedure.

15.2.3 *-Gauge retention force (resilient contacts)*

15.2.3.1 *Procedure and requirements*

Resilient contacts, either female (socket) or male (pin), shall be tested in the following manner using the specified gauges:

a) The gauge causing maximum deformation shall be applied to the contact and withdrawn three times. For a centre female contact, the diameter of the gauge shall be the maximum specified diameter of the mating male contact. For the outer male contact, the inner diameter of the gauge shall be the minimum specified diameter of the female body.

Note. — 'The use of an oversize test gauge may be called for in the relevant specification.

b) The gauge causing minimum deformation shall then be engaged with the contact. The contact shall support the gauge when the gauge is hanging from the contact-in a vertical position. For a centre female contact, the diameter of the gauge shall be the minimum specified diameter of the mating male contact. For an outer male contact, the inner diameter of the gauge shall be the maximum specified diameter of the female body.

15.2.3.2 *Information to be given in the relevant specification*

a) dimensional details of the gauge(s) for pre-conditioning;

b) dimensional details and mass of the gauge(s) for checking the retention force;

c) when required the insertion force of the pre-conditioning gauge(s);

d) any deviation from the standard test procedure.

15.2.4 *Centre contact captivation*

1X2.4.1 Procedure

Free connectors shall be fitted with an appropriate cable and fixed connectors with a wire.

An axial torque and/or force, as specified by the relevant specification, shall be applied smoothly to the centre contact. The relevant specification shall also prescribe the magnitude, the duration and the sense of application of torque and/or force.

15.2.4.2 *Requirements*

After removal of the stress, the permanent displacement of the centre contact with regard to the connector body shall notexceed the value specified in the relevant specification.

15.2.4.3 Information to be given *in* the *relevant specification*

a) appropriate cable to be used;

b) magnitude, duration and sense of torque and force;

c) any deviation from standard procedure and requirements.

15.2.5 *Robustness of terminations*

This test has been omitted from this second edition.

15.2.6 *Static load (for fixed connectors only)*

This test has been omitted from this second edition.

15.3 *Engagement* and separation forces and torques

15.3.1 *General*

Engagement is the action of fully inserting the connector and operating the coupling mechanism, if any. Separation is the reverse procedure. Engagement and separation involve axial movements requiring insertion and withdrawal forces. Operation of the coupling mechanism may involve additional rotary movement of a coupling ring requiring a torque.

Note.— Connectors with threaded coupling nuts are covered by Sub-clause 15.5.

15.3.2 *Procedure*

The test shall be carried out on connector pairs or with a gauge if specified by the relevant specification. There shall be five successive cycles of engagement and separation on the same test specimens. The forces and torques as applicable shall be measured on the fifth cycle.

15.3.3 *Requirements*

The insertion force and the coupling torque shall not exceed the value specified by the relevant specification. The momentary maximum decoupling torque and withdrawal force shall be within the limits specified by the relevant specification.

15.3.4 *Information to be given in the relevant specification*

a) maximum value of insertion force and coupling torque, where applicable;

b) momentary maximum and minimum values permitted for the decoupling torque, where applicable, and the withdrawal force;

c) any deviation from the standard procedure.

15.4 Mechanical tests on cable fixing

15.4.1 *Object*

To determine whether the device for fixing or clamping the cable is effective when tensile forces and/or torques are applied to the attached cable.

15.4.2 *Effect of cable rotation (nutation of cable end)*

15.4.2.1 Procedure

An appropriate cable shall be attached to the connector according to the manufacturers' instructions.

The length of the cable shall be equal to three times the specified minimum cable bending radius.

The connector shall be held in a convenient way and the free end of the cable deflected to such an amount that the minimum bending radius will be obtained. Holding this deflection constant, the cable end shall then be moved along a circle in a plane perpendicular to the axis of the connector for a prescribed number of revolutions (nutations). During this procedure, the cable shall not rotate within the attachment to the connector.

15.4.2.2 *Requirements*

After the test, the cable shall not show any sign of deterioration due to rubbing.

15.4.2.3 *Information to be given in the relevant specification*

a) necessary characteristics of the appropriate cable;

b) minimum bending radius of the cable;

c) number of revolutions (nutations);

d) any deviation from the standard test method.

15.4.3 *Effectiveness of clamping device against cable pulling*

15.4.3.1 Procedure

An appropriate cable of specified length shall be attached to the connector(s) and the connector suitably fixed.

A tensile force as specified by the relevant specification shall be applied to the free end of the cable along the common axis of the cable and connector. If connectors are fitted at both ends of the cable, the force shall be applied between the two connectors, along the common axis of the cable and connectors.

If explicitly specified, the reflection factor shall be measured.

15.4.3.2 *Requirements*

Neither the dielectric nor the sheath shall have moved in relation to the cable outlet of the connector(s).

If specified, the reflection factor shall not exceed the prescribed value.

15.4.3.3 *Information to be given in-the relevant specification*

a) cable to be used and its length;

b) value of the force, method of applying the force and its point of application;

c) duration of application of the force;

d) requirements for the reflection factor, if applicable;

e) any deviation from the standard test procedure.

15.4.4 *Effectiveness of clamping device* against cable *bending*

15.4.4.1 Procedure

An appropriate cable shall be attached to the connector according to the manufacturer's instructions.

The length of the cable shall be specified by the relevant specification.

The assembled connector shall be held or clamped in a horizontal position. A bending force shall then be applied to the cable by attaching to its free end a specified mass, sufficient to cause the cable to assume its minimum bend radius commencing at the point of cable entry into the connector.

The mass is then removed and the cable returned to its original straight position. These operations shall be regarded as one bending cycle.

The number of bending cycles shall be prescribed by the relevant specification.

15.4.4.2 *Requirements*

After the test, the cable shall still be firmly attached to the connector with no visible deterioration of the connector-to-cable junction.

15.4.4.3 *Information* to *be* given *in the relevant specification*

a) type of cable to be used;

b) minimum bending radius of the cable;

c) length of cable, measured from connector cable entry to point of attachment of the mass;

d) value of the mass necessary to produce the minimum bending-radius;

e) number of bending cycles;

f) any deviation from the standard test method.

15.4.5 *Effectiveness of clamping device against cable torsion*

15.4.5.1 *Procedure*

An appropriate cable of specified length shall be attached to the connector(s) and the connector suitably fixed.

An axial torque of specified magnitude and duration shall be applied to the end of the straight cable. If connectors are fixed at both ends of the cable, the torque shall be applied between the two connectors, these and the cable having a common axis.

15.4.5.2 *Requirements*

The cable shall neither slip nor rotate in relation to the connector(s).

15.4.5.3 *Information **to be given in the relevant specification***

a) the cable to be used and its length;

b) value of the torque and method of its application;

c) duration of application of the torque;

d) any deviation from the standard test procedure.

15.5 ***Strength of coupling mechanism***

15.5.1 Object

To determine the mechanical ability of the coupling mechanism to withstand an axial tensile-force and, additional in the case of screw coupled connectors, a proof torque.

15.5.2 ***Procedure***

An axial tensile force shall smoothly be applied to mated connector pairs the coupling of which, in the case of screw coupled connectors, has been tightened to the normal coupling torque.

In the case of screw coupled connectors, the coupling is then additionally tightened to the proof torque and loosened again three times.

15.5.3 ***Requirements***

No damage shall occur and the coupling mechanism shall not fail.

If required by the relevant specification, the connector pairs shall then be subjected to the tests and measurements of Sub-clause 15.3 and shall meet the requirements specified by the relevant specification.

15.5.4 ***Information to be given in the relevant specification***

a) value of the force and method of application;

b) duration of application of the force;

c) value of normal coupling torque;

d) value of proof torque;

e) number of connector pairs to be tested;

f) requirement whether or not the tests and measurements of Sub-clauses 15.3 shall be applied;

g) any deviation from the standard test procedure.

15.6 ***Bending moment*** (and shearing force)

15.6.1 ***Procedure***

Mated sets of connectors shall be subjected to a bending moment in such a way that the coupling mechanism is stressed.

One of the connectors shall be fixed either by the normal means of attachment (fixed connector), or by a suitably strong clamp (free connector). The bending moment shall be produced by a force perpendicular to the connector axis at a suitable distance from the reference plane. If appropriate a special mechanical test plug shall be used for this purpose. The force shall be applied smoothly.

Note. — This method of producing the bending moment causes also a shearing force which may be kept small by using a long lever arm.

156.2 *Requirements*

No damage shall occur and the coupling mechanism shall not fail.

The connector pairs shall then be subjected to the tests and measurements of Sub-clause 15.3 and shall meet the requirements specified by the relevant specification.

15.6.3 Information to be given in the relevant specification

a) value of the force and the point of its application;

b) duration of application of the force;

c) anydeviation from the standard test procedure.

15.7 *Bump*

15.7.1 Procedure

The bump test shall be carried out in accordance with IEC Publication 68-2-29: Test Eb and Guidance: Bump, on mated pairs of connectors.

The connectors shall be attached to a suitable length of appropriate cable and the mated pair of connectors mounted in one of the following ways as prescribed by the relevant specification:

a) clamping both the connectors and the cable;

b) clamping the cables only and thus leaving the connectors freely suspended;

c) if one of the connectors is a fixed style, this connector shall be mounted in accordance with Clause 11.

The preferred severity shall be 4 000 ± 10 bumps at an acceleration of 390 m/s^2 (40 g) with a pulse duration of 6 ms.

The relevant specification shall state in which directions and senses the specified bumps shall be applied.

During the bumping the centre and outer contact continuity shall be monitored as specified in Sub-clause 14.4.

15.7.2 *Information to be given in the relevant specification*

a) appropriate cable to be used and its length;

b) details of mounting of connectors and cables;

c) severities;

d) directions and senses of conditioning;

e) performance requirements;

f) any deviation from the standard procedure.

15.8 *Shock*

15.8.1 *Procedure*

The shock test shall be carried out in accordance with IEC Publication 68-2-27: Test Ea and Guidance: Shock, on a mated pair of connectors.

The connectors shall be attached to a suitable length of appropriate cable and the mated pair of connectors mounted in one of the following ways as prescribed by the relevant specification:

a) clamping both the connectors and the cable;

b) clamping the cables only and thus leaving the connectors freely suspended;

c) if one of the connectors is a fixed style, this connector shall be mounted in accordance with Clause 11.

The shock test severity to be prescribed by the relevant specification shall, preferably, be selected from amongst the following preferred values:

Peak acceleration	Duration of pulse	Form of pulse
294 m/s² (30 g) 490 m/s² (50 g) 981 m/s² (100 g)	18 ms 11 ms 6 ms	Half-sine

The relevant specification shall state in which directions and senses the specified shocks shall be applied, and the number of shocks.

During each shock, the centre and outer contact continuity shall be monitored as specified in Sub-clause 14.4.

15.8.2 *Information to be given in the relevant specification*

a) appropriate cable to be used and its length;

b) details of mounting of connectors and cables;

c) severities;

d) directions and senses of conditioning;

e) performance requirements;

f) any deviation from the standard procedure.

16. Climatic conditionings and tests

16.1 *Introduction*

16.1.1 Survey of *conditionings*

The climatic conditionings and tests comprise the following:

a) connectors of the climatic categories x/x/21 and x/x/56 shall be subjected to the climatic sequence based on the Standard Climatic Sequence in Clause 7 of IEC Publication 68-1, consisting of the individual conditionings:

- dry heat; Test Ba, IEC Publication 68-2-2;
- damp heat, cyclic; first cycle of Test Db, IEC Publication 68-2-30;
- cold; Test Aa, IEC Publication 68-2-1;
- low air pressure; Test M, IEC Publication 68-2-13;
- damp heat, cyclic; remaining cycle(s) of Test Db;

b) test Ca: Damp heat, steady state, IEC Publication 68-2-3;

c) test Na: Change of temperature, IEC Publication 68-2-14, Clause 1;

d) test Q: Sealing, IEC Publication 68-2-17;

e) test Ka: Salt mist, IEC Publication 68-2-11;

f) test Kc: Sulphur dioxide test for contacts and connections, IEC Publication 68-2-42;

g) test L: Dust and sand (under consideration).

16.1.2 *General procedure*

From a sub-sample of connectors subjected to the conditioning procedures and subsequent recovery period, half the numbers of specimens shall be mated and half the number shall stay unmated, unless otherwise specified.

An appropriate cable shall be attached to cable connectors and the free ends prepared in such a way that inner and outer conductors can be electrically connected for measuring purposes. Where-necessary the free ends shall be treated to prevent ingress of moisture. Fixed connectors shall be mounted in accordance with Clause 11, and the back of panel portion shall, where appropriate, be protected against ingress of moisture.

Note.— Special attention should be paid to connector specimens intended for the measurement of the reflection factor, see Sub-clause 14.1.

The climatic severities for the low and high temperatures, and the duration of the damp heat, steady state, exposure shall correspond to the climatic category of the connector, as prescribed by the relevant specification.

If applicable, the specimens shall be pre-conditioned and then visually examined and electrically and mechanically checked prior to subjecting them to the conditionings and tests, as prescribed by the relevant specification.

16.2 Climatic *sequence*

16.2.1 *Dry* heat

This test shall be carried out in accordance with Test Ba of IEC Publication 68-2-2, using the appropriate degree of severity.

The connectors shall be exposed to the specified temperature for a period of 16 h. At the end of this period, and whilst still at the high temperature, the insulation resistance shall be measured and shall not be less than the value prescribed by the relevant specification.

The connectors shall then be removed from the, chamber and kept under standard atmospheric conditions for testing during not less than 2 h before subjecting them to the next conditioning.

An interval not exceeding 72 h is, however, permitted at this stage of the procedure, during which the specimens shall be kept under standard atmospheric conditions for testing.

16.2.2 *Damp heat, cyclic; first cycle*

This test shall be carried out in accordance with Test Db of I EC Publication 68-2-30.

The connectors shall be subjected to this test with an upper temperature of 55 °C for a first cycle of 24 h followed by the exposure to controlled recovery conditions for 1 h 30 to 2 h.

Where prescribed by the relevant specification measurements shall be made on the specimens at the end of the recovery period.

The connectors shall then immediately be submitted to the cold test.

16.2.3 *Cold*

This test shall be carried out in accordance with Test Aa of I EC Publication 68-2-1, using the appropriate degree of severity.

The duration of the exposure shall be 2 h or as otherwise prescribed by the relevant specification, followed by the exposure to standard recovery conditions for 1 h 30 to 2 h or as otherwise prescribed by the relevant specification.

The connectors shall then be visually examined and they shall show no sign of deterioration.

An interval not exceeding 72 h is permitted at this stage of the procedure, during which-the specimens shall be kept under standard atmospheric conditions for testing.

16.2.4 ***Low airpressure***

This test shall be carried out in accordance with Test M of I EC Publication 68-2- 13, using the appropriate degree of severity.

The duration of the exposure shall be 1 h at standard temperature for testing (15 °C to 35 °C).

Where prescribed by the relevant specification, a voltage proof test shall be carried out during the last 5 min of the exposure. There shall be no sign of glow discharge, breakdown or flashover.

An interval not exceeding 72 h is permitted at this stage of the procedure, during which the specimens shall be kept under standard atmospheric conditions for testing.

16.2.5 ***Damp heat, cyclic; remaining cycle(s)***

The connectors shall then be subjected, again with an upper temperature of 55 °C, to the remaining cycle(s) of Test Db, namely:

Category x/x/21 .... 1 cycle,
Category x/x/56 .... 5 cycles,

followed by the exposure to controlled recovery conditions for 1 h 30 to 2 h.

Where extended recovery is prescribed in the relevant specification, the specimens shall remain under standard atmospheric conditions for testing for a further period of 24 h.

16.2.6 ***Concluding tests***

At the conclusion of the recovery period, the connectors shall meet the requirements of the relevant specification for the following properties, unless otherwise specified:

Mated connectors	***Unmated connectors***
a) Contact resistance	***a)*** Insulation resistance
b) Voltage proof	***b)*** Voltage proof
c) Visual inspection.	c) Contact resistance on resilient contacts individually
	d) Sealing
	e) Visual inspection.

Notes 1. — The insulation resistance measurement and the voltage proof test should be carried out within 30 min of the recovery period.

2. — The mated connectors should not be disturbed prior to the contact resistance measurement.

16.2.7 ***Information to be given in the relevant specification***

a) pre-conditioning procedure, if any;

b) electrical and mechanical checks to be made before conditioning;

c) severity of each step of the climatic sequence;

d) minimum value of insulation resistance at high temperature;

e) requirements for the final measurements;

f) requirement of extended recovery, if any;

g) any deviation from the standard test procedure.

16.3 ***Damp heat, steady-state***

16.3.1 Procedure

This test shall be carried out in accordance with Test Ca of IEC Publication 68-2-3, using the appropriate degree of severitiy.

Immediately after removing of the specimens from the test chamber a voltage, as specified by the relevant specification, shall be applied to the connectors for 5 min. There shall be no breakdown or flashover.

The specimens shall then be exposed to the standard atmospheric recovery conditions for 1 h 30 to 2 h.

16.3.2 *Final tests and measurements*

At the conclusion of the recovery period the connectors shall meet the requirements of the relevant specification for the following properties, unless otherwise specified:

Mated connectors	*Unmated connectors*
a) Contact resistance	*a)* Insulation resistance
b) Voltage proof	*b)* Voltage proof
c) Visual inspection.	c) Contact resistance on resilient contacts individually
	d) Visual inspection.

Notes 1. — The insulation resistance measurement and the voltage proof test should be carried out within 30 min of the recovery period.

2. — The mated connectors should not be disturbed prior to the contact resistance measurement.

16.3.3 *Information to be given in the relevant specification*

a) voltage for the test immediately after conditioning;

b) requirements for the final measurements;

c) any deviation from the standard procedure.

16.4 *Rapid change of temperature*

16.4.1 *Procedure*

This test shall be carried out in accordance with Test Na of IEC Publication 68-2-14, Clause 1.

The low conditioning temperature shall be the low category temperature, and the high temperature the high category temperature of the specimens.

The number of cycles shall be 5 and the duration of exposure to each of the two temperatures 30min or such longer period as specified by the relevant specification to ensure achievement of thermal equilibrium.

At the end of the last cycle, the specimens shall be subjected to standard atmospheric conditions for recovery for 1 h 30 to 2 h.

16.4.2 *Finaltests and measurements*

At the conclusion of the recovery period, the connectors shall meet the requirements of the relevant specification for the following properties, unless otherwise specified:

Mated connectors	*Unmated connectors*
a) Contact resistance	*a)* Insulation resistance
b) Voltage proof	*b)* Voltage proof
c) Visual inspection.	c) Contact resistance on resilient contacts individually
	d) Sealing
	e) Visual inspection.

Notes 1. — The insulation resistance measurement and the voltage proof test should be carried out within 30 min of the recovery period.

2. — The mated connectors should not be disturbed prior to the contact resistance measurement

16.4.3 ***Information to be given in the relevant specification***

a) requirements for the final tests and measurements;

b) any deviation from the standard test procedure.

16.5 Sealing

16.5.1 ***Non-hermetic sealed*** connectors

16.5.1.1 ***General***

Non-hermetic sealed connectors are connectors with seals of any kind whose leakage may have a magnitude detectable by one of the test methods Qa or Qc of IEC Publication 68-2-17.

The connectors are regarded as having Type B seals (seals working in both directions), but a test in one direction only, as for Type A seals, is considered satisfactory.

16.5.1.2 ***General***

The test shall be carried out in accordance with Test Qa of I EC Publication 68-2-17.

Panel sealed, as well as panel and barrier sealed connectors (thus fixed connectors) shall be mounted on a rigid plate forming part of a test jig (a closed box) permitting the application of the required air pressure.

Free connectors fitted both with barrier and mating face seals shall be tested by mating them with an appropriate complementary fixed connector permanently mounted with a panel seal to the test jig but allowing the passage of air to the free space inside the mated connectors.

Free connectors fitted only with barrier seal, but no mating face seal, shall be appropriately sealed to the test jig. This may be achieved by means of a constricting compression gland of a suitable size to grip the body shell.

16.5.1.3 ***Requirements***

At the standard pressure difference of 100 kPa to 110 kPa (1 bar to 1.1 bar), the leakage rate shall not exceed the limit given by the relevant specification; in no case, however, shall it exceed 1 bar $\cdot$ cm^3/h.

16.5.1.4 ***Information to be given in the relevant specification***

a) requirements for pressure;

b) requirements for leakage rate;

c) any deviation from the standard test procedure.

16.5.2 ***Hermetically sealed connectors***

16.5.2.1 Procedure

The test shall in principle be carried out in accordance with Test Qk of IEC Publication 68-2-17, thus using a tracer gas (helium) with a mass spectrometer. The test set-up and the procedure shall be as follows:

The connector shall be mounted in accordance with the manufacturer's instructions on a rigid plate and covered on one side by a hollow cap forming a well-sealed cavity. This cavity is connected to the mass spectrometer by a pipe, preferably with a valve, and evacuated. The visible part of the connector is covered either by a sealed flexible pocket (for instance of plastic material) or another sealed metallic cap, the cavity of which is filled with helium at the standard pressure of 100 kPa (1 bar) absolute.

For quantitative measurements, the test set-up shall be calibrated, using a calibrated leak in place of the connector to be tested.

Leaks at the test specimen may be localized by sweeping it with a fine jet of helium at low pressure, the flexible pocket or the cap, of course, being omitted.

16.5.2.2 ***Requirements***

The leakage rate under standard conditions as mentioned above shall not exceed 1 O-3 Pa · cm^3/s (10^{-8} bar . cm^3/s), unless otherwise prescribed by the relevant specification.

16.5.2.3 ***Information to be given in the relevant specification***

a) test paranieter, if different from standard value(s);

b) limit of leakage rate, if different from value mentioned above;

c) any deviation from the standard procedure.

16.6 Mould growth

This test has been omitted from this second edition.

16.7 *Salt mist*

This test shall be carried out in accordance with Test Ka of I EC Publication 68-2-11 at the severity prescribed by the relevant specification.

At the conclusion of the recovery procedure and period, the connectors shall meet the requirements as follows, unless otherwise prescribed by the relevant specification:

a) visual inspection;

b) engagement and separation shall be achievable in the normal manner by hand.

16.8 Dust

Under consideration.

16.9 *Sulphur dioxide test*

16.9.1 ***Procedure***

This test shall be carried out in accordance with Test Kc of IEC Publication 68-2-42. Unless otherwise specified, the direct injection method of generating the conditioning atmosphere as given in Appendix A of the publication shall be used.

Note. — This test may be preceded by the mechanical endurance test.

The duration of exposure to be prescribed by the relevant specification shall, preferably, be selected from amongst the following preferred values:

4,10 or 21 days.

The specimens shall then be removed from the chamber and stored under standard atmospheric recovery conditions for 1 h 30 to 2 h.

16.9.2 ***Final tests and measurements***

At the conclusion of the recoveryperiod, the connectors shall meet the requirements of the relevant specification for the following properties, unless otherwise specified:

Mated connectors	*Unmated connectors*
a) Contact resistance.	*a)* Contact resistance, immediately after first engagement of pairs.
b) Visual inspection.	*b)* Visual inspection.

Note. — The mated connectors should not be disturbed prior to contact resistance measurement.

16.9.3 *Information to **be given in the relevant specification***

a) measurements, checks and mechanical endurance test to be made prior to the test;

b) duration of the exposure;

c) requirements for the final measurements;

d) any deviation from the standard test procedure.

17. Mechanical endurance

17.1 *Procedure*

Connectors shall be subjected to a mechanical endurance test in accordance with the relevant specification. If required, the endurance test may be divided into two parts, separated by other tests.

The endurance test consists of repeated engagement and disengagement of connector pairs. One operation consists of full engagement, including the operation of the coupling mechanism, if any, with screw coupled connectors being tightened to the normal coupling torque, and subsequent disengagement.

When permitted by the relevant specification the locking devices, where fitted, may be tested separately from the insertion and withdrawal action; thus there will be two series of tests.

The number of operations shall be 500, unless otherwise specified. The relevant specification shall give the frequency of the operation, duly taking into account that the sliding speed during the engagement and disengagement of the connectors should be 0.1 m/s max.

17.2 *Final tests and measurements*

At the conclusion of the endurance conditioning, the connectors shall meet the requirements of the relevant specification for the following properties, unless otherwise specified:

a) contact resistance, using the same pairs as subjected to the endurance test:

b) voltage proof;

c) engagement and separation forces and torques;

d) gauge retention force:

e) sealing.

17.3 *Information to be given in the relevant specification*

a) frequency of the operations, maximum sliding speed 0.1 m/s;

b) number of operations, if other than 500;

c) requirements for the final measurements;

d) any deviation from the standard test procedure.

18. High temperature endurance

18.1 *Procedure*

This test shall be carried out on mated pairs of connectors.

The chamber used for this test shall be capable of maintaining in any region where the specimens are placed the specified endurance temperature with a tolerance of ± 5°C. The specimens shall not be exposed to direct radiation from the heating elements of the chamber.

Unless otherwise specified, the specimens shall be introduced into the chamber while its air temperature is at 70% of the specified endurance temperature. Once thermal equilibrium has been achieved the temperature of the chamber shall be increased to the endurance temperature.

The endurance severity to be prescribed by the relevant specification shall, preferably, be selected from the following preferred values:

— endurance temperature:	85 °C 125°C 155°C;
— duration:	50 h 250 h.

Following the endurance conditioning, the specimens shall be exposed to the standard atmospheric recovery conditions for 1 h 30 to 2 h.

18.2 *Final-measurements*

At the conclusion of the recovery period, the connectors shall meet the requirements of the relevant specification for the following properties, unless otherwise specified:

a) contact resistance;

b) insulation resistance;

c) voltage proof;

d) sealing.

Note. — The mated connectors should not be disturbed prior to the contact resistance measurement.

18.3 *information to be given in the relevant specification*

a) temperature and duration for the endurance conditioning;

b) requirements for final measurements;

c) any deviation from the standard test procedure

19. Resistance to solvents and contaminating fluids

19.1 *Procedure*

One separate pair of unmated connectors shall be immersed during 18 h in each of the test fluids to which they are declared resistant, as prescribed in the relevant specification.

Fluids with possible detrimental effect on r.f. connectors are given in the following two lists, together with the temperature at which the conditioning should be carried out.

List I

Fuels, lubricants, hydraulic fluids and anti-freeze agents:

Chemical description	Test temperature
a) A mixture of toluene (aromatic) 30% and isoctane (aliphatic) 70% (volume)	40 ± 2 °C
b) Wide cut aviation turbine fuel	70 ± 2 °C
Fluids *a)* and *b)* are representative of the worst possible combination of solvents likely to be encountered in connector applications.	
c) Di-octyl sebacate (aircraft turbine engine lubrication oil)	150 ± 2 °C
d) Mineral oil, viscosity approximately 15 cSt at 38 °C	70 ± 2 °C
e) Castor oil 20%, 2-ethoxyethanol 80% (volume) (this represents a normal hydraulic fluid)	20 ± 2 °C

Chemical description	Test temperature
f) Phosphate ester hydraulic **fluid** (**synthetic** hydraulic fluid)	70 ± 2 °C
g) **Dimethyl** silicone fluid (high temperature hydraulic fluid)	150 ± 2 °C
h) Lithium soap/synthetic oil grease (low temperature grease)	20 ± 2 °C
i) Monopropylene glycol (de-icing fluid)	20 ± 2 °C

List 2

Cleaning agents and moisture repellents:

a) Carbon tetrachloride	15 °C to 35 °C
b) Trichloroethylene, Type C	15 °C to 35 °C
c) White spirit	15 °C to 35 °C
d) Petroleum jelly	15 °C to 35 °C

Warning note. — Many of the fluids listed are highly inflammable and may also have toxic effects.

After completion of the conditioning, the specimens shall be wiped clean of surplus fluid and then allowed to dry for 2 h at 70 °C, unless a lower value is prescribed by the relevant specification, whereupon they are exposed to standard atmospheric recovery conditions for 1 h 30 to 2 h.

Note. — Materials commonly used in r.f. connectors are not susceptible to chemical attack by a number of solvents and contaminants. However, contamination of the dielectric surfaces may lead to serious degradation of the electrical properties. Previous test evidence may exist which establishes beyond all reasonable doubt that specific solvents and contaminants will not cause failure of connectors to meet the electrical and physical requirements of the relevant specifications. In this situation, agreement may be reached between manufacturer and user that further testing is unnecessary.

19.2 **Final** *measurements*

At the conclusion of the recovery period, the connectors shall meet the requirements of the relevant specification for the following properties, unless otherwise specified:

a) insulation resistance;

b) engagement and separation;

c) visual inspection.

19.3 *Information to be given in the relevant specification*

a) applicable conditioning fluids;

b) drying temperature, if different from 70 °C;

c) requirements for final measurements;

d) any deviation from the standard test procedure.

APPENDIX A

GUIDANCE
SC-HEDULE FOR TYPE APPROVAL TESTS

This schedule shows the grouping of most of the tests described in Chapter II, as they may be needed for a type approval test. Within the groups, the tests shall be carried out in the order given, unless otherwise specified.

Evidently not all test groups nor all tests are applicable in each particular case. The relevant specification shall specify which groups and, within the groups, which test shall apply.

All specimens of a test sample shall be subjected to the tests and measurements of Group A. Then the sample shall be divided into independent sub-samples of equal number of specimens, unless otherwise prescribed by the relevant specification. Four pairs of connectors are, in general, considered adequate for each sub-sample.

Test or conditionings	Clause and sub-clause	Intermediate and final measurements
A Test group *A*		
A1 Visual inspection	12	
A2 Dimensions	13	
A3 Gauge retention force	15.2.3	
A4 Mechanical compatibility	15.3	Engagement and separation five times maximum, in order to check compatibility, without measuring forces and torques
A5 Insulation resistance	14.5	
A6 Sealing	16.5	
B Test *group B*		
B1 Reflection factor	14.1	
B2 Contact resistance	14.3	
B3 Mechanical endurance	17	Contact resistance Voltage proof Engagement and separation forces and torques
B4 High temperature endurance	18	Contact resistance Insulation resistance Voltage proof Sealing
Note. — The connectors may be cleaned prior to subjecting them to test B4.		
C *Test group C*		
Screening effectiveness	14.8	
D *Test group D*		
D1 Engagement and separation	15.3	Forces and torques
D2 Voltage proof	14.6	
D3 Vibration	15.2.2	Contact continuity, Sub-clause 14.4
D4 Bump	15.7	Contact continuity, Sub-clause 14.4
D5 Shock	15.8	Contact continuity, Sub-clause 14.4
D6 Damp heat, steady state	16.3	Voltage proof *Mated connectors*: Contact resistance, Voltage proof, Visual inspection *Unmated connectors*: Insulation resistance, Voltage proof, Contact resistance, Visual inspection
D7 Salt mist	16.7	Visual inspection Engagement and separation by hand

Test or conditionings	Clause and sub-clause	Intermediate and final measurements	
E ***Test group E***			
E1 Mechanical tests on cable fixing:	15.4		
— Cable rotation (nutation)	154.2		
— Cable pulling	15.4.3		
— Cable bending	15.4.4		
— Cable torsion	15.4.5		
E2 Strength of coupling mechanism	15.5		
E3 Bending moment	15.6		
F ***Test group F***			
F1 Soldering	15.2.1		
F2 Contact captivation	15.2.4		
F3 Power rating	14.2		
F4 Discharge test	14.11		
F5 Rapid change of temperature	16.4	***Mated connectors***	***Unmated connectors***
		Contact resistance	Insulation resistance
		Voltage proof	Voltage proof
		Visual inspection	Contact resistance
			Visual inspection
F6 Climatic sequence	16.2		
— Dry heat	16.2.1	Insulation resistance at high temperature	
— Damp heat (first cycle)	16.2.2		
— Cold	16.2.3		
— Low air pressure	16.2.4	Voltage proof	
— Damp heat (remaining cycle(s))	16.2.5	***Mated connectors***	***Unmated connectors***
		Contact resistance	Insulation resistance
		Voltage proof	Voltage proof
		Visual inspection	Contact resistance
			Sealing
			Visual inspection
G Test group G			
Sulphur dioxide test	16.9	***Mated connectors***	***Unmated connectors***
		Contact resistance	Contact resistance
		Visual inspection	Visual inspection
Note. — May be preceded by mechanical endurance test.			
H ***Test group H***			
Resistance to solvents and contaminating fluids	19	Insulation resistance	
		Engagement and separation	
		Visual inspection	

(Continued from second cover)

International Standard	***Corresponding Indian Standard***	***Degree of Correspondence***
IEC 68-2-6 : ***1982*** : Test Fc and guidance : Vibration (sinusoidal)	IS 9000 (Part 8) : 1981 Basic environmental testing procedures for electronic and electrical items: Part 8 Vibration (sinusoidal) test	Technically equivalent
IEC ***68-2-11*** : ***1981*** : Test Ka : Salt mist	IS 9000 (Part 11) : 1983 Basic environmental testing procedures for electronic and electrical items: Part 11 Salt mist test	do
IEC 68-2-13 : 1981 : Test M : Low air pressure	IS 9000 (Part 13) : 1981 Basic environmental testing procedures for electronic and electrical items: Part 13 Low air pressure test	do
IEC 68-2-14 : 1984 : Test N : Change of temperature	IS 9000 (Part 14) : 1988 Basic environmental testing procedures for electronic and electrical items: Part 14 Test N: Change of temperature	do
IEC 68-2-17: 1978: Test Q: Sealing	IS 9000 (Part 15) : 1982 Basic environmental testing procedures for electronic and electrical items: Part 15 Sealing test	do
IEC 68-2-20 : 1979 : Test T : Soldering	IS 9000 (Part 18/Sec 1) : 1981 Basic environmental testing procedures for electronic and electrical items: Part 18 Solderability test, Section 1 Solderability of wire and tag terminations	do
IEC ***68-2-27*** : ***1986*** : Test Ea and guidance : Shock	IS 9000 (Part 7/Sec 1) : 1979 Basic environmental testing procedures for electronic and electrical items: Part 7 Impact test, Section 1 Shock	do
IEC 68-2-29 : 1986 : Test Eb and guidance : Bump	IS 9000 (Part 7/Sec 2) : 1979 Basic environmental testing procedures for electronic and electrical items: Part 7 Impact test, Section 2 Bump	do
IEC 68-2-30 : ***1980*** : Test Db and guidance : Damp heat, cyclic (12+12-hour cycle)	IS 9000 (Part 5/Sec 2) : 1981 Basic environmental testing procedures for electronic and electrical items: Part 5 Damp heat (cyclic) test, Section 2 12+12h cycle	do
IEC 68-242 : 1976 : Test Ke : Sulphur dioxide test for contacts and connections	IS 9000 (Part 26) : 1980 Basic environmental testing procedures for electronic and electrical items: Part 26 Sulphur dioxide test for contacts and connections	do
IEC 169-l-l : 1987 : Radio frequency connectors, Part 1 : General requirements and measuring and methods, Section 1 Electrical tests and measuring procedures — Reflection factor	IS 5054 (Part 1/Sec 2) : 1995 Radio frequency connectors : Part 1 General requirements and measuring methods, Section 2 Electrical tests and measuring procedures — Reflection factor (second ***revision)***	Identical

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